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THE GENUS ASTROCYSTIS

WILLIAM W. DIEHL

(WITH PLATE 19)

Astrocystis mirabilis B. & Br. (**1**: 123, *fig. 36*) was described in 1873 from material on dead culms of bamboo. It was the type of a genus to which no species have since been added. The erumpent condition of the perithecium coupled with the peculiar volva-like appearance at its base were regarded as sufficient cause for generic segregation; but from the figure (l.c.) and the lack of further explanation it is to be inferred that this *volva* is simply revolute host tissue.

Penzig and Saccardo (**6**: 7. *pl. IVd. fig. 3*) considered the general structure of the mature perithecium to be that of a *Rosellinia* but did not alter the nomenclatorial status of the species nor did they explain further the character of the ascocarp.

Von Höhnel (**4**: 326–328) showed that in development up to maturity—he states "zur volligen reife"—the perithecium remains sub-epidermal. He did not regard it as a *Rosellinia* and referred the species, apparently solely upon this subepidermal condition, to *Anthostomella*, relegating *Astrocystis* to the position of a section in the genus. Von Höhnel did not, however, discuss the nature of the perithecial wall which should have a bearing upon the generic position of the fungus. Previous to emergence the stromatic character of the perithecial wall is not prominent. In all specimens examined where the ascoscarps were still immersed, the asci and spores, although definitely formed, were of

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much smaller dimensions than those considered mature; the spores were also light brown and translucent by comparison. There seems no reason for considering this immersed condition other than immature.

The position of young perithecia is extremely variable. Sections of some specimens show the structure to be seated just above the innermost layer of the hypodermis, *i.e.*, intrahypodermal; the hypodermis here is a well-defined tissue of three to four layers of sclerenchymatous cells. A portion of these cells is plainly replaced by the stroma, the perithecial base then appearing subhypodermal. In some specimens the perithecium is subcuticular, in others subepidermal. It is probable that the character of the tissues of individual host species may determine the position of perithecial development. The varying relations of the ascocarp to the host tissues in this species show the disadvantage of considering position as an important criterion in separating certain genera.

Sections of matured, erumpent perithecia *in situ* clearly show a stromatic wall extremely thickened except near the apex. This stromatic structure is usually, but not always, definitely split into irregular segments giving a characteristically asteroid, basal periphery or *pseudo-volva*. In the emergence of the perithecium the overlying host tissue is split in a definitely stellate manner, the segments becoming revolute and subtending the stromatic pseudo-volva as an additional stellate collar. This collar of host tissue, to which some stromatic fungus tissue usually adheres, is illustrated and referred to by Berkeley and Broome (l.c.) as the *volva*. The stellate splitting of the pseudovolva is less evident in the subcuticular than in the subepidermal or intrahypodermal perithecia. In all types of emergence, however, there is a definite exfoliation of stroma from the upper part of the perithecium leaving that area smooth or evenly granular.

The stromatic pseudo-volva of the perithecium may well be homologous to the sclerotic subicle frequently found in *Rosellinia* and in the Cucurbitariaceae. The fact that in early maturity the perithecium is similar to *Anthostomella* in form and position is merely suggestive of the possible phylogeny of the species. Since it is distinct from the conception of either *Rosellinia* or

Anthostomella, there is no valid reason for referring *Astrocystis* to the status of a subgenus or section of either. If stromatic characters are to be regarded as important criteria in distinguishing genera, *Astrocystis mirabilis* may best remain as the type of a distinct genus which has evident affinities among the Sphaeriaceae with *Anthostomella* and *Rosellinia* and among the Xylariaceae with *Hypoxylon*. Lindau (**5**: 411) has given *Astrocystis* a doubtful position in the Cucurbitariaceae, but it is so plainly allied with certain Sphaeriaceae that its disposition in the latter family seems desirable for the present.

It has not been possible to find among the species of *Anthostomella* growing on Bambuseae any which are definitely recognizable as cospecific with *Astrocystis mirabilis*. But there can be little doubt that *Rosellinia geasteroides* Ellis & Ev. (**2**: 415–416) and *R. Bambusae* P. Henn. (**3**: 256) are synonyms; the former is an intrahypodermal condition, the latter described as superficial. *Rosellinia Bambusae* has previously been considered synonymous by Rehm (**7**: 1940) and by Sydow (**9**: 486). Although Rehm (**8**: 2939) has relegated to synonymy with this species both *Auerswaldia Arengae* Rac. and *Anthostomella discophora* Syd., the stromatic characters of neither seem sufficiently in agreement with it to justify such disposition. Through the kindness of Dr. A. D. Cotton and Miss E. M. Wakefield of the Royal Botanic Gardens, Kew, it has been possible to obtain type material for comparison with the other specimens examined.

SYSTEMATIC ACCOUNT

Astrocystis B. & Br., Jour. Linn. Soc. **14**: 123. 1873.

Type species, *Astrocystis mirabilis* B. & Br.

Perithecia separate, rarely connivent, scattered to cespitose, subsuperficial to intrahypodermal and erumpent, subspherical, definitely flattened at the base, characterized when mature by a stromatic development of the outer wall and base, carbonous, rigid, apically ostiolate; asci cylindrical to clavate, 8-spored; ascospores simple, brown, walls smooth; paraphyses present.

Probably most closely related to *Rosellinia* and referred to the Sphaeriaceae, but in stromatic structure suggestive of the Xylariaceae.

Astrocystis mirabilis B. & Br., Jour. Linn. Soc. **14**: 123. 1873.

Rosellinia geasteroides Ell. & Ev., Proc. Acad. Nat. Sci. Phila. **1895**: 415–416. 1896.

Rosellinia Bambusae P. Henn., Hedwigia **47**: 256. 1908.

Anthostomella mirabilis (B. & Br.) v. Höhn., Sitz. Akad. Wiss. Wien 118[1]: 326–328. 1909.

ILLUSTRATIONS: B. & Br., Jour. Linn. Soc. **14**: *fig. 36;* Penz. & Sacc., Ic. Fung. Javan. *pl. IVa. fig. 3.*

Perithecia separate, rarely connivent, infrequent to cespitose, subsuperficial or immersed (subcuticular, subepidermal, or intrahypodermal), becoming erumpent and subspherical, 300–800 μ in diameter, in emergence usually splitting the overlying matrix in a stellate manner; outer perithecial wall thin toward the apex, thickened equatorially and toward the base as a pseudoparenchymatous, carbonous stroma; in development the stroma exfoliating tangentially in the region of the ostiole leaving the upper perithecial surface finely granular or smooth; exfoliated stroma partly attached to stellate segments of the ruptured matrix; the thickened stromatic outer wall of the perithecium variable in dimension and appearance but extending as a *pseudovolva* which is frequently ruptured radially with a resultant stellate periphery; ostiole papillate; perithecial cavity subspherical, reaching 600 μ in diameter; asci arising chiefly from the base of the perithecial cavity, cylindrical-clavate to cylindrical, subsessile, thin walled, evanescent, 60–100 x 6–13 μ (sec. Penz. & Sacc. 120–130 x 6–7 μ), with 8 spores uniseriately or irregularly arranged; ascospores acuminate or rounded, elliptical, narrow to broad, light brown becoming dark brown and subopaque, when mature 10–21 x 4–12 μ, chiefly 11–13 x 5–7 μ, walls thin, smooth, brittle; paraphyses flexuous, exceeding the asci in length, nearly 1 μ in diameter, gelatinizing and early evanescent.

DISTRIBUTION: Apparently cosmopolitan in tropical and subtropical regions upon Bambuseae.

SPECIMENS EXAMINED:

Ceylon: Type material (*Thwaites No. 785*), ex. herb. Roy. Bot. Gard. Kew.

Louisiana: 1895—on *Arundinaria* sp. A. B. Langlois *2404*. Type coll. of *Rosellinia geasteroides*.

1895—on *Arundinaria* sp. A. B. Langlois—Ell. & Ev., N. Am. Fungi *3315* as *R. geasteroides*.

1896—on *Arundinaria* sp. A. B. Langlois—Path. Coll. *6406*.

Philippine Islands: 1912—on Bambusaceae—P. W. Graff. Sydow: F. exot. exs. *126* as *R. Bambusae.*

1913—on *Gigantochloa Scribneriana*, C. F. Baker: F. Malayana *5* Suppl. *1* as *Anthostomella mirabilis*, det. Rehm.

1913—on *Bambusa vulgaris*, C. F. Baker: F. Malayana *5* as *A. mirabilis*, det. Rehm.

1914—on *Schizostachyum* sp. C. F. Baker: F. Malayana *110* as *A. mirabilis* f. *Schizostachyi* Rehm, det. Rehm.

1915—on *Schizostachyum* sp. C. F. Baker: F. Malayana *5* suppl. *2* as *Astrocystis mirabilis*, det. Sydow.

1913—E. D. Merrill, Bu. Sci. *9111.*

1914—on *Schizostachyum* sp. E. D. Merrill, Bu. Sci. *9712.*

1912—on *Schizostachyum* sp. Bu. Sci. *16983.* M. Ramos.

1915—on *Bambusa*, R. C. McGregor, Bu. Sci. *23207.*

1912—on *Bambusa*, P. W. Graff, Bu. Sci. *19007*, det. Sydow —in U. S. Nat. Herb.

1906—E. D. Merrill, Bu. Sci. *5030.* Type coll. of *Rosellinia Bambusae* in U. S. Nat. Herb.

Java: 1908—on *Bambusa* sp. v. Höhnel. Rehm: Ascomycetes *1859* as *Anthostomella mirabilis.*

Except where noted otherwise, all the specimens cited above are in the Pathological Collections B. P. I.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

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8. **Rehm, H.** Ascomycetes philippinenses VIII. Elmer, Leafl. Philip. Bot. **6**: 2935–2961. 1916.
9. **Sydow, H. & P.** Enumeration of Philippine fungi, etc. II. Philip. Jour. Sci. **8**: C, 475–508. 1913.

EXPLANATION OF PLATE 19

Photographs: fig. 1 by Mr. E. L. Crandall and figs. 2, 3 by Mr. M. L. S. Foubert of the U. S. Department of Agriculture.

Fig. 1. Perithecia × 20 from type material of *Astrocystis mirabilis*.

Fig. 2. Perithecium in longitudinal section (tangential) × 60; material from A. B. Langlois, Path. Coll. *6406*.

Fig. 3. Perithecium in longitudinal section (through the region of the ostiole) × 60, material same as of fig. 2.

Fig. 4. Diagrammatic drawing of longitudinal section of intrahypodermal perithecium to show interrelation of fungous and host tissues: *A*, Fertile inner wall of perithecium; *B*, outer stromatic wall (pseudo-volva) of perithecium; *C*, fragments of stroma adherent to host tissue; *D*, cuticle; *E*, epidermis; *F*, hypodermis.

Fig. 5. Diagrammatic drawing of longitudinal section of subcuticular perithecium, designation as in fig. 4.

PHYSALOSPORA AND BOTRYOSPHAERIA

THE LIFE HISTORY AND RELATIONSHIPS OF DIPLODIA GOSSYPINA

NEIL E. STEVENS

(WITH PLATE 20)

In the course of a study of those species of *Botryosphaeria* and *Physalospora* which cause such well known diseases as currant cane-blight, black rot of apples and stem-end rot of citrus fruits (**10**, **11**, **12**, **13**) much information has been obtained about the closely related *Diplodia gossypina* found on cotton and other plants in the southern states. The importance of *Diplodia gossypina* Cooke as a cause of boll rot of cotton (*Gossypium hirsutum*) has been pointed out by Edgerton (**3**) who published a careful description of the disease and of the pycnidial stage of the fungus. Edgerton also described a somewhat similar rot of cotton bolls caused by a species of *Botryosphaeria* which he referred provisionally to *B. fuliginosa* (M. & N.) E. & E. (**2**).

Continued collecting and study of the species of *Botryosphaeria* and *Physalospora* have shown that the perfect stage of *D. gossypina* is a *Physalospora* closely related to *P. malorum*, and that this fungus apparently is not confined to cotton but occurs on several other hosts in the southeastern United States. The evidence on these points is summarized in the present paper. There is also included a brief comparison of the genera *Physalospora* and *Botryosphaeria* with special reference to the species known to occur on cotton. The synonymy of the names *Diplodia gossypina* Cooke and *Botryosphaeria fuliginosa* (M. & N.) E. & E. is discussed only so far as is necessary to fix their status with reference to the fungi considered in this paper.

DIPLODIA GOSSYPINA COOKE

Diplodia gossypina was described by Cooke (**1**) in 1879 as follows:

Diplodia gossypina Cooke. Gregaria, erumpens. Peritheciis sub-conicis, atris, subtus applanatis, fibrosis. Sporis ellipticis, olivaceo-brunneis, .022 x .012 mm.

On old capsules of *Gossypium*. Bombay (India). Washington, U. S. A. (Mr. T. Taylor).

This citation of specimens would suggest that material from two localities was examined when the description was prepared but in Cooke's herbarium at Kew, Doctor Shear was able to find only a single specimen under the name *D. gossypina*. This is labeled "*Diplodia gossypina* Cooke, Washington, U. S., T. Taylor, December, 1878." Spores from this specimen measure 20–27 x 10–15 μ, mostly 23–25 x 12–13 μ, and agree very well in size and appearance with Edgerton's description of pycnospores of the cotton boll rot *Diplodia* and with the spores which have developed in pure culture from single ascospores. Edgerton (**3**) suggests that the *Diplodia* on cotton may be the same as that found on other hosts, and that it may have been described under some other name previous to 1879. It is apparent, however, that the fungus with which we are dealing is identical with that described by Cooke as *D. gossypina* and as this name has become established by the use of Edgerton and others, it will be employed in this paper.

The fungus described by Ellis and Bartholomew (**5**) from cotton stems as *Botryodiplodia Gossypii* is apparently identical with *Diplodia gossypina*. Material of this species was distributed as Fungi Columbiani No. *1510*. Under this number in the set examined by the writer there are two specimens, one of which is apparently *Diplodia gossypina* and the other one contains a *Botryosphaeria* apparently identical with that found on cotton and other hosts in the eastern United States and which has been referred to as *Botryosphaeria Ribis*, in the earlier papers (**10**, **11**).

BOTRYOSPHAERIA FULIGINOSA (M. & N.) E. & E.

As already noted, Edgerton (**2**) provisionally referred the *Botryosphaeria* which he found on cotton to *B. fuliginosa* (M. & N.) E. & E. As Edgerton notes, Shear (**9**) had in 1909 called attention to the fact that *B. fuliginosa* was among the names applied in America to the grape fungus which he calls *Melanops Quercuum* (Schw.) Rehm *forma Vitis* Sacc., the pycnidial stage of which he had produced in pure culture from single ascospores and found to agree in all morphological characters with *Sphaeropsis malorum* Peck.

Apparently neither Shear nor Edgerton intended to give the impression that the fungi they were discussing were identical with *Botryosphaeria fuliginosa*, as the name is used by Ellis and Everhart (**6**), but merely to indicate that the name *B. fuliginosa* was one which had been used in referring to fungi similar to those with which they were dealing. This is undoubtedly true, since Ellis and Everhart, as is evident from their description and figures of *B. fuliginosa*, included under this name representatives of both *Botryosphaeria* and *Physalospora* as these genera are now understood. The reasons for the interpretation of this species made by them are somewhat fully given by Ellis (**4**) in his paper published in 1879, "On the Variability of *Sphaeria Quercuum*, Schw." (**10, 11**).

Ellis cites a number of species which he considers synonymous with *Sphaeria Quercuum* Schw. and says (**4**, p. 68):

"In all these different forms the character of the fructification is the same, or at most there is only a slight variation in the size of the asci and sporidia, so that from a microscopical examination of the fruit alone it would be impossible to say to which of the above species any particular specimen should be referred. This similarity will be readily seen on examining the figures in Grevillea illustrating the species cited. All have the same broad clavate, obtuse, stipitate asci which are often subject to a kind of deformity, being bent almost double. The paraphyses are simple, or sparingly branched, of a gelatinous nature, and, like the asci, soon dissolved. . . ."

"From an examination of the above notes it will be seen that, disregarding the somewhat variable ostiola, the various forms above noted differ from each other only in the fact that in some the perithecia are confluent and united in a partial stroma, while in others they are scattered and without any distinct stroma. The only question then is whether this variation alone is sufficient to constitute a specific difference" (p. 69).

Ellis, of course, did not take into consideration the pycnidial stages of the fungi he was discussing. He had, in fact, almost no information as to their life histories, and it is in the life histories of these fungi that their most conspicuous differences are found. The difference which Ellis notes in the arrangement of the perithecia would not *alone* appear "sufficient to constitute a specific difference" but this difference proves to be correlated with a

marked difference in the life histories of the organisms and thus becomes of real significance.

As will be pointed out below the perfect stages of these two genera are very similar in many respects, and the conclusion as to their relationship reached by Ellis is that which any competent mycologist might well have reached after a study based only on the morphological characters of the fungi unassisted by pure culture studies. The numerous species of these genera which have been described have been based almost wholly on their host relations and as Ellis and Everhart remark (**6**, p. 547), "Without knowing the host, it would be impossible to separate them." The distinctions which it is now possible to make between the perfect stages of these two fungi were discovered and it may fairly be assumed were discoverable only after continued study of the life histories and cultural characters of the species of these two genera from different hosts.

The species of these two genera resemble each other in the general appearance of their fruiting bodies on many hosts. The contents of the perithecia in both genera are pure white (see pl. 20), a character which is very useful in collecting. The ascospores are very similar in shape, as may be seen from Table III, in which are tabulated the ratios of length to width of 802 ascospores of *Botryosphaeria Ribis*, on seventeen hosts, and 1213 ascospores of *Physalospora malorum* from twenty-two hosts.

Moreover, while the ascospores differ in size they overlap somewhat (**9**, **10**), that is the largest ascospores of *B. Ribis* are equal in size to the smaller ones of *P. malorum*. The separation of these species by morphological studies alone was rendered particularly difficult by the fact that certain species of both genera occur on the same host. Indeed, mature perithecia of species of the two genera are often found intermingled within a square centimeter of host bark.

The differences in the two genera as exemplified by *Botryosphaeria Ribis* and *Physalospora malorum* have been pointed out in two earlier papers (**10**, **11**). They may be briefly summarized as follows: The most important character, as was suggested above, is the difference in their life histories. *Botryosphaeria* has a *Dothiorella* as its pycnidial stage, and *Physalospora* a

TABLES I TO III

ASCOSPORE MEASUREMENTS

Table I. Lengths	Total no. of spores	Number of spores having a given length in microns																							
		18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Physalospora malorum on 23 hosts (see **11**, p. 99)	1213	1		4		9	23	40	57	75	161	148	105	169	90	123	74	61	37	18	10	7		1		
Physalospora gossypina on cotton	100								2	2	5	6	5	17	3	23	6	7	12	8	4					
Physalospora gossypina on 5 hosts listed on p. 197	687							3	17	11	28	26	27	74	43	115	88	63	87	46	28	15	3	9	2	2

Table II. Widths	Total no. of spores	Number of spores having a given width in microns											
		6	7	8	9	10	11	12	13	14	15	16	17
Physalospora malorum on 23 hosts (see **11**, p. 99)	1213	1	34	75	173	331	281	207	78	27	4	2	
Physalospora gossypina on cotton	100			3	17	37	25	12	5	1			
Physalospora gossypina on 5 hosts listed on p. 197	687		1	7	14	53	90	182	154	108	67	10	1

Table III. Ratios of length to width	Total no. of spores	Number of spores having a given ratio of length to width							
		1.5	2	2.5	3	3.5	4	4.5	5
Botryosphaeria Ribis on 17 hosts (see **11**, p. 99)	802	15	141	280	258	76	25	3	4
Physalospora malorum on 23 hosts (see **11**, p. 99)	1213	1	112	461	426	150	44	15	4
Physalospora gossypina on cotton	100		4	21	47	14	10	3	1
Physalospora gossypina on 5 hosts listed on p. 197	687		88	397	172	26	4		

Sphaeropsis. Ascospores of *B. Ribis* measure from 13–28 x 4–10 μ, mostly 17–22 x 6–8, while those of *P. malorum* measure 18–40 x 7–14 μ, mostly 30–34 x 8–10. There is also a characteristic difference in the germination of the ascospores of the two species in agar plates at temperatures from 12° to 15° C. Under these conditions ascospores of *B. Ribis* usually develop two short, branched germ tubes, while those of *P. malorum* usually develop a single germ tube which remains unbranched until it reaches a length which is fifty or more times the length of the spore. Perithecia of *B. Ribis* average about 165 x 130 μ in size, perithecia of *P. malorum* average about 245 x 210 μ. Several perithecia of *B. Ribis* usually occur in a single stroma and even where a single perithecium occurs there is usually a noticeable amount of stromatic tissue associated with it. Perithecia of *P. malorum*, on the other hand, usually occur singly and with little associated stromatic tissue.

The differences in size and in the appearance of the perithecia of the two fungi on a single host are clearly illustrated by the figures of the two forms on oak given by Ellis and Everhart. The figures here reproduced as Figures *A* and *B* of Plate 20 are from a photograph made by Mr. J. F. Brewer of the original drawings by F. W. Anderson of Plate 36 of Ellis and Everhart, now the property of Dr. C. L. Shear. The accuracy of these drawings is attested by the fact that even though the authors believed they were dealing with a single species the characteristic differences in the size and arrangement of the perithecia are fully brought out.

Before our studies of this group of fungi are concluded it is hoped to make a critical comparison of type and authentic material of many of the species which have been referred to the various closely allied genera, including most of the species listed by Ellis and Everhart as synonyms of *Botryosphaeria fuliginosa*. This cannot be done at present. Examination of the figures here reproduced and of the spore measurements given by Ellis and Everhart (**6**), 18–38 x 8–15 μ, can leave no doubt that they included under this name representatives of both *Botryosphaeria* and *Physalospora* as these genera are now understood.

THE BOTRYOSPHAERIA ON COTTON

In describing the *Botryosphaeria* on cotton which he referred tentatively to *B. fuliginosa*, Edgerton (**2**) pointed out that the pycnidial stage belonged to the form genus *Macrophoma* which he used as equivalent to *Dothiorella* as defined by Shear, Stevens, and Wilcox (**10**) and that this fungus was specifically distinct from *Diplodia gossypina*. With his conclusion the observations of the present writer agree. It is then no longer desirable to use the name *B. fuliginosa*, which was never a valid name for any of these fungi, in connection with this fungus which is apparently identical with that found on numerous other hosts in the eastern United States and which has been clearly defined and called (**11**) *Botryosphaeria Ribis* G. & D. Whether both the forms of *B. Ribis* which have been recognized are found on cotton is not yet certain. Since, however, *B. Ribis* has been found well distributed over the southeastern United States and *B. Ribis chromogena* has been found on apples as far south as Fort Valley, Ga., it is probable that both forms will be found on cotton.

THE PHYSALOSPORA ON COTTON AND OTHER HOSTS IN THE SOUTHERN STATES

The pycnidial stage of the fungus here called *Diplodia gossypina* is very common on cotton in the southeastern United States. No reference to its connection with a perithecial stage can, however, be found in available literature. In March, 1924, at Madison, Fla., the writer collected on cotton stems a fungus very similar to *Physalospora malorum* as described under the name of *P. Cydoniae* by Hesler (**8**) and later as *P. malorum* (**10**), but having slightly larger ascospores. A number of single ascospore cultures were made from this material, in all of which there developed pycnospores identical with *D. gossypina*.

Mature perithecia of a fungus, which is apparently identical with the *Physalospora* on cotton, were found during the same collecting trip on the following hosts in the southern states: *Hicoria* (four localities), *Ilex*, *Liquidambar*, *Quercus* (twenty-three localities) and *Vitis*. Single ascospore cultures were made from each separate lot of material on all of these hosts and in all

cases the pycnospores produced were identical with *D. gossypina*. While the size of the sporocarps of this fungus varies as in *P. malorum* (**12**) with the nature and thickness of the host bark, they agree so closely in all other respects, both in the perithecial and pycnidial stages, that the conclusion that they belong to the same species seems unavoidable. The similarity in size of the ascospores from the various hosts is shown in Tables I to III. The relative size of the ascospores of this fungus and that of *Botryosphaeria Ribis*, which is also found on cotton and other hosts in the southern states, may be seen in Plate 20, Figures C, D, E, and F, also (**11**, Pl. 9, Figs. A, F, K).

It is highly probable that the perfect stage of this fungus already has been described from some host in the southern states. The writer has, however, so far been unable to establish this fact and is thus under the necessity of designating it as *Physalospora gossypina*.

The only characters which the writer has thus far found which will serve to distinguish the perfect stage of this fungus from that of *P. malorum* is a slight difference in the size of the perithecia and the difference in the size of the ascospores. Perithecia of *P. gossypina* usually average about 294 x 245 μ in diameter, while perithecia of *P. malorum* average about 245 x 210 μ in diameter. As will be observed from Tables I and II, the ascospores of the cotton fungus measure 24–42 x 7–17 μ, mostly 30–35 x 11–14. Those of *P. malorum*, on the other hand, measure 18–40 x 6–16 μ, mostly 27–32 x 9–12. The spores of the two fungi are so similar in shape that one would hesitate to separate them on ascospore characters alone.

The pycnospores of these two fungi are, however, readily distinguished by the difference in their size and shape, in the color of the mature spores, and the frequency with which septate spores are found. While the pycnospores of the two fungi are much alike in length, *P. malorum* measuring 17–32 μ and *D. gossypina* 17–35 μ, there is more difference in their widths, pycnospores of *P. malorum* measuring 7–15 μ, mostly 12, while those of the cotton fungus measure 9–23 μ, mostly 14. This difference in width is of course reflected in their shape as expressed in their ratio of length to width, the most frequent ratio in pycnospores of *P.*

malorum being 2.5 μ, while in *D. gossypina* it is 2 μ. Pycnospores of *P. malorum* almost always become colored in the pycnidium, indeed full-sized hyaline spores are seldom found. The spores of *D. gossypina*, on the other hand, rarely become colored until they are ready to be discharged from the pycnidium and numerous hyaline spores may be found in almost any section of a mature pycnidium.

Colored spores of *D. gossypina*, on the other hand, are usually septate, whereas septate spores are very rare in *S. malorum*. The light brown spore wall of *S. malorum* is smooth or very finely punctate, while in the somewhat darker spore wall of *D. gossypina* there may often be detected longitudinal striations similar to those figured by Evans (**7**) in *D. natalensis*.

It will be noted that these are exactly the characters used to distinguish *P. malorum* (**13**) from the fungus common on citrus in Florida and Cuba and generally known as *Diplodia natalensis*. The pycnidial stages of *D. gossypina* and *D. natalensis* are, in fact, so far as the writer has yet discovered, indistinguishable morphologically. As explained in an earlier paper (**13**), material of the perithecial stage of *D. natalensis* has not yet been obtained in sufficient quantity to make a careful study and comparison possible. Until such a comparison is made, it will probably be wiser to consider them as separate species and retain the names now in use. One conspicuous physiological character serves to distinguish the citrus stem-end rot *Diplodia* in culture from the fungus found on cotton and other hosts. This is the temperature relation of the two fungi. As noted in an earlier paper, *D. natalensis* (**13**) will grow fairly well on agar in plates at 36° to 37° C. The cotton fungus, on the other hand, will not grow at these temperatures and grows only very slowly at 31° to 32° C. The above statements must not be interpreted as meaning that the high temperature *Diplodia* never occurs on oak or cotton, or that the low temperature *Diplodia* does not occur on *Citrus* or even as a cause of stem-end rot of citrus fruits. It is, on the contrary, probable that each will occasionally be found on the host habitually occupied by the other. There is, as yet, no evidence whatever that the *Diplodia* species common in the southeastern United States are limited to certain hosts. It is

not possible at this time to review the rather extensive literature relating to the *Diplodia* species known to cause diseases of cultivated plants. It may be well to state, however, that the writer has not yet met any investigator who regarded the species as limited to particular hosts. The prevalent opinion, on the other hand, among those who have studied these *Diplodia* diseases in the field is that the common species of *Diplodia* pass readily from one host to another.

SUMMARY

The perfect stage of *Diplodia gossypina* proves to be a *Physalospora* closely related to *P. malorum*.

The perfect stage of this fungus, which is provisionally called *Physalospora gossypina*, is distinguished from *P. malorum* by having slightly larger perithecia and ascospores.

The pycnospores of the two fungi are easily distinguished by their size, color, and the relative number of septate spores.

Diplodia gossypina cannot be distinguished at present from *Diplodia natalensis* on morphological grounds, but *D. natalensis* is able to grow at higher temperatures than *D. gossypina*.

Botryosphaeria fuliginosa, as used by Ellis and Everhart, includes species belonging to both the genera *Botryosphaeria* and *Physalospora* as now understood. It was apparently never a valid name for any of these fungi. The name *Botryosphaeria Ribis* G. & D. is now applied to the *Botryosphaeria* on cotton.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

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EXPLANATION OF PLATE 20

A. Perithecial stroma of *Botryosphaeria* sp. (× 20.) Reproduced from a photograph by James F. Brewer of the original drawing of figure 2, plate 36, in Ellis & Everhart's "North American Fungi," in which it is designated as *Botryosphaeria fuliginosa* (M. & N.), somewhat enlarged on decaying limb of *Quercus coccinea*.
B. Mature perithecia of *Physalospora* sp. (× 20.) Reproduced as was figure *A* from figure I, plate 36, in Ellis & Everhart's "North American Fungi," where it is designated as *Botryosphaeria fuliginosa* (M. & N.), somewhat enlarged on an oak gall.
C. Asci of *Botryosphaeria Ribis* from *Aesculus*, Washington, D. C. (× 560.)
D. Ascospores from same material as *C*. (× 560.)
E. Asci of *Physalospora gossypina* from *Quercus*, Eden, Miss. (× 560.)
F. Ascospores from the same material as *E*. (× 560.)
G. Pycnospores of *Diplodia gossypina* Cooke from his type material. (×615.)
H. Pycnospores of *Physalospora gossypina*, grown in pure culture from single ascospores. (× 615.)

SMUTS AND RUSTS OF UTAH—V[1]

A. O. Garrett

USTILAGINALES

29*. Tilletia foetens (B. & C.) Trel. Par. Fungi Wisc. 35. 1884.

In ovaries of *Triticum vulgare* Vill. Collected by Miss Clara Anderson, at Murray, Salt Lake Co., April 1, 1924.

UREDINALES

8. Melampsora confluens (Pers.) Jackson.

Caeoma confluens (Pers.) Schröt.

On *Ribes aureum* Pursh: I, Collected by George A. Root in Ogden Canyon, Weber County, June 17, 1921. This is the first collection of *Melampsora confluens* on this host.

On *Salix Scouleriana* Barratt: *3009a*, II, August 26, 1921, Brighton Resort, Big Cottonwood Canyon, Salt Lake Co.; *3027*, August 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

9. Gymnosporangium Nelsoni Arthur. I, III.

On leaves of *Amelanchier polycarpa* Greene: *2718a*, I, Aug. 3, 1920, Beaver Canyon, Beaver Co.; *3017*, I, Aug. 31, 1921, Spring Hollow, Logan Canyon.

On *Juniperus scopulorum* Sarg.: *2686a*, III, July 27, 1920, Coal Creek branch of Cedar Canyon, Cache Co.

The *Gymnosporangium* mentioned in the discussion of *Gymnosporangium gracilens* (No. 152 in "Smuts and Rusts of Utah") belongs here.

[1] The previous papers of "Smuts and Rusts of Utah" were published in Mycologia as follows: I, **2**: 265–304, Nov., 1910; II, **6**: 240–258, Sept., 1914; III, **11**: 202–215, July, 1919; IV, **13**: 101–110, March, 1921.

Numbers followed with the asterisk (*) are those of species not included in any of the four preceding lists.

11. MELAMPSORA BIGELOWII Thüm. II.

On *Salix subcoerulea* Piper: *3009*, Aug. 20, 1921, Fish Lake Resort, Sevier Co. Rust determined by Dr. J. C. Arthur; host by Dr. P. A. Rydberg.

15. MELAMPSORELLA ELATINA (Alb. & Schw.) Arthur. I.

Peridermium elatinum (Alb. & Schw.) Schw. & Kze.
Melampsorella cerastii Schröt.

On *Abies concolor* (Gord.) Parry: *3114*, I, July 12, 1924, Nature's Icebox Spring, Community Flat, Mt. Timpanogos, Utah Co.

21. PHRAGMIDIUM MONTIVAGUM Arthur. II.

On *Rosa neomexicana* Cockerell: *3026*, Aug. 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

On *Rosa pyrifera* Rydb.: *3007*, Aug. 20, 1921, Fish Lake Resort, Sevier Co.

22. PUCCINIA ABSINTHII DC. II.

On *Artemisia aromatica* A. Nels.: *2995*, Aug. 12, 1921, Marysvale, Piute Co.

On *Artemisia tridentata* Nutt.: Spring Hollow, Logan Canyon, Cache Co.

On *Sphaeromeria diversifolia* (D. C. Eaton) Rydb.: *3011*, Aug. 27, 1921, Pharaoh's Glen, Parley's Canyon, Salt Lake Co. This is the first collection of this rust on this host.

45. PUCCINIA DOUGLASII Ellis & Ev.

On *Phlox canescens* T. & G.: *2606*, June 25, 1920, Manti, San Pete Co.

55. PUCCINIA GRAMINIS Pers.

On *Elymus glaucus* Buckley: *2691*, III, Aug. 27, 1921, Coal Creek Canyon near Cedar City, Iron Co. Weathered material.

On stems and leaves of *Phleum pratense* L.: *3063*, Sept. 16, 1922, west side of Weber River, near bridge at Wanship, Summit Co. Not before reported from Utah on this host.

Arthur (N. Am. Flora **7**: 296. 1920) mentions a collection of this rust made in Utah on *Agropyron caninum* (L.) Beauv.

69. PUCCINIA JONESII Peck. I.

On the leaves of *Aulospermum longipes* (Wats.) C. & R.: *3109*, I, collected by Miss La Rue Larsen, May 27, 1924, Salt Lake City. This is the first collection of *Puccinia Jonesii* on this host.

80. PUCCINIA MUTABILIS Ellis & Gall. I.

Aecia on a single leaf of *Allium Diehlii* M. E. Jones, collected in Parley's Canyon, Salt Lake Co., are tentatively referred to this species.

81. PUCCINIA PIMPINELLAE (Str.) Mart.

P. Osmorrhizae (Peck) Cooke & Peck.

On *Glycosma occidentalis* Nutt.: *3021*, III, Spring Hollow, Logan Canyon, Cache Co.

88. PUCCINIA EPIPHYLLA (L.) Wettst. II.

Puccinia Poarum Niels.

On *Catabrosa aquatica* (L.) Beauv.: *3004*, Fish Lake Resort, Sevier Co.

96. PUCCINIA SHERARDIANA Körn. III.

On *Sphaeralcea coccinea* (Nutt.) Rydb.: *2983*, August 10, 1921, Manti, San Pete Co.

105. PUCCINIA SUBNITENS Dietel. I.

On *Atriplex rosea* L.: *2802*, May 14, 1921, Granger, Salt Lake Co.

On *Camelina microcarpa* Andrz.: *2799*, May 14, 1921, Granger, Salt Lake Co.

On *Capsella Bursa-pastoris* Medic.: *2803*, May 14, 1921, Granger, Salt Lake Co.

On *Erysimum repandum* L.: *2801*, May 14, 1921, Granger, Salt Lake Co.

On *Lepidium simile* Heller: *2798*, May 14, 1921, Granger, Salt Lake Co.

On *Hutchinsia procumbens* (L.) Dev.: *2794*, May 14, 1921, Granger, Salt Lake Co.

On *Sophia intermedia* Rydb.: *2800*, May 14, 1921, Granger, Salt Lake Co.

Arthur (N. Am. Flora **7**: 306. 1920) records a collection of *P. subnitens* made in Utah on *Chenopodium pratericola* Rydb.

115. PUCCINIA TUBERCULANS Ellis & Ev. III.

On *Chrysothamnus puberulus* (Eat.) Greene: *2605*, June 26, 1920, Manti, San Pete Co.

On *Chrysothamnus marianus* Rydb.: *2990a*, Aug. 10, 1921, Manti, San Pete Co.

116. PUCCINIA UNIVERSALIS Arthur. II, III.

On *Carex festivella* Mackenzie: *2745a*, Brighton Resort, Big Cottonwood Canyon, Salt Lake Co.

On *Carex* sp.: *2634*, II, July 15, 1920, Gogorza, Summit Co.

119. PUCCINIA VIOLAE (Schum.) DC.

On *Viola adunca* J. E. Smith: *3024*, Spring Hollow, Logan Canyon, Cache Co.

123. PUCCINIASTRUM PUSTULATUM (Pers.) Dietel. II.

On *Epilobium americanum* Haussk.: *2988*, Aug. 10, 1921, Manti, San Pete Co.; *3012*, Aug. 27, 1921, Pharaoh's Glen, Parley's Canyon, Salt Lake Co.

131. UROMYCES INTRICATUS Cooke. II.

U. Eriogoni Ellis & Hark.

On *Eriogonum biumbellatum* Rydb.: *3001*, Aug. 20, 1921, Fish Lake Resort, Sevier Co.

On *Eriogonum microthecum* Nutt.: *2646*, July 17, 1920, Maple Canyon branch of Coal Creek Canyon, near Cedar City, Iron Co.

On *Eriogonum racemosum* Nutt.: *2674a*, July 22, 1920, Zion National Park, Washington Co.

135. UROMYCES HETERODERMUS Syd. III.

On *Erythronium grandiflorum parviflorum* S. Wats.: *2587*, May 16, 1920, City Creek Canyon, Salt Lake Co. Collected by Garrett & Posey.

137. UROMYCES FABAE (Pers.) De Bary.

On *Lathyrus utahensis* Jones: *2690*, Maple Creek branch of Coal Creek Canyon, near Cedar City, Iron Co.

138. UROMYCES OCCIDENTALIS Dietl.

On *Lupinus* sp.: *2993*, Aug. 12, 1921, Marysvale, Piute Co.

148. COLEOSPORIUM RIBICOLA (C. & E.) Arthur. II.

On *Ribes inebrians* Lindl.: *3002*, Aug. 20, 1921, Fish Lake Resort, Sevier Co. All of the Utah collections of *Coleosporium ribicola* have been made on this host, heretofore designated in these notes as *R. cereum*.

150. CRONARTIUM PYRIFORME (Peck) Hedg. & Long. II, III.

On *Comandra pallida* A. DC.: *3025*, Aug. 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

151. GYMNOSPORANGIUM CLAVARIAEFORME (Jacq.) DC. I.

On *Amelanchier florida* Lindl.: *3000*, Aug. 20, 1921, Fish Lake Resort, Sevier Co. The specimens of *Amelanchier* were growing next to bushes of *Juniperus Siberica*. The rust on *Amelanchier* was abundant.

153. GYMNOSPORANGIUM INCONSPICUUM Kern. I.

On fruit of *Amelanchier prunifolia* Greene: *2692*, July 22, 1920, Zion's National Park, Washington Co.

154. MELAMPSORA ALBERTENSIS Arthur. II.

On water-sprouts of *Populus tremuloides* Michx.: *3018*, Aug. 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

155. PHRAGMIDIUM OCCIDENTALE Arthur.

On *Rubus parviflorus* Nutt.: Aug. 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

164. PUCCINIA GRINDELIAE Peck.

P. Gutierreziae Ellis & Ev.

On *Gutierrezia glomerella* Greene: *2682*, July 23, 1920, Hurricane, Washington Co.; *2657*, July 17, 1920, Maple Creek branch of Coal Creek Canyon, near Cedar City, Iron Co.

165. PUCCINIA GROSSULARIAE (Schum.) Lagerh.

On *Carex* sp.: *3013*, Aug. 27, 1921, Pharaoh's Glen, Parley's Canyon, Salt Lake Co.

168. PUCCINIA OBLITERATA Arthur. I.

On *Aquilegia flavescens* Watson: *3113*, July 12, 1924, glacial cirque above Aspen Grove, Mt. Timpanogos, Utah Co. This is

the first collection of this species in Utah on *A. flavescens*. Dr. Arthur now considers *Puccinia obliterata* to be a form of *Puccinia Clematidis* (DC.) Lagerh.

176. PUCCINIA VARIOLANS Hark. III.

On *Tetradymia Nuttallii* T. & G.: *2990*, Aug. 10, 1921, Manti, San Pete Co.

187. CRONARTIUM OCCIDENTALE Hedg., Bethel & Hunt. II, III.

On *Ribes aureum* Pursh: *2982*, Aug. 10, 1921, Manti, San Pete Co.; *2991*, Aug. 12, 1921, Marysvale, Piute Co.; *2996*, Aug. 14, 1921, Panguitch, Garfield Co.; *2997*, Aug. 16, 1921, Mt. Carmel, Kane Co.; *2998*, Aug. 17, 1921, Richfield, Sevier Co. All of the above are new county records for the occurrence of this *Cronartium*.

188. GYMNOSPORANGIUM BETHELI Kern. I, III.

On leaves of *Crataegus rivularis* Nutt.: *3016*, Aug. 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

On *Juniperus scopulorum* Sarg.: *3020*, Aug. 31, 1921, Spring Hollow, Logan Canyon, Cache Co.

189. GYMNOSPORANGIUM JUVENESCENS Kern.

On leaves of *Amelanchier florida* Lindl.: *3014*, I, Aug. 27, 1921, above Pharaoh's Glen, Parley's Canyon, Salt Lake Co.

On leaves of *Amelanchier Jonesiana* C. K. Schneider: *2661a*, I, July 19, 1920, Coal Creek Canyon near Cedar City, Iron Co.

On leaves of *Amelanchier polycarpa* Greene: *2645*, I, July 17, 1920, Maple Creek branch of Coal Creek Canyon, near Cedar City, Iron Co.

On leaves of *Amelanchier utahensis* Koehne: *2643*, I, July 16, 1920, Coal Creek Canyon near Cedar City, Iron Co.

All hosts of the above collections were determined by Dr. Rydberg and all rusts by Dr. Arthur.

214* PUCCINIA CICUTAE Lasch. Klotzsch, Herb. Viv. Myc. *787*. 1845.

On *Cicuta occidentalis* Greene. Collected by Wyatt W. Jones, Sept. 7, 1922, at Charleston, Wasatch Co. Not before reported from Utah.

215* PUCCINIA POLYGONI-AMPHIBII Pers. Syn. Fung. 227. 1801.

On *Persicaria psycrophila* Greene: *3062*, II, III, Sept. 16, 1922, west bank of Weber River, near bridge east of Wanship, Summit Co. Host determined by Dr. Rydberg.

On *Persicaria Hartwrightii* (A. Gray) Greene. Listed in N. Am. Flora (**7**: 381. 1920) as occurring in Utah on this host.

217* PUCCINIA POLYGONI-VIVIPARI H. Dietr. P. Karst. Not. Faun. Fl. Fenn. (**8**: 21. 1869).

On *Bistorta bistortoides* (Pursh) Small (*Polygonum bistortoides* Pursh). Collected by H. F. Bergman in Logan Canyon, Cache Co., August 17, 1917.

218* UROMYCES FALLENS (Desm.) Kern, Phytopathology **1**: 6. 1911.

On *Trifolium pratense* L. Collected by Wyatt W. Jones at Provo, Utah Co., Oct. 23, 1918.

219* UROMYCES RICKERIANUS Arthur, Bull. Torrey Club **29**: 227. 1902.

On *Rumex pauciflorus* Nutt.: *2632*, III, July 15, 1920, Gogorza, Summit Co.; *3035*, I, same locality, June 15, 1922.

220* UROMYCES SHEARIANUS Arthur, Bull. Torrey Club **46**: 120. 1920.

On *Atriplex confertifolia* (Torr.) S. Wats. Listed in N. Am. Flora (**7**: 443. 1921) as occurring in Utah on this host.

221* UROMYCES SILENES (Schlecht.) Fckl. Symb. Myc. 61. 1869.

On *Arenaria glabrescens* (Wats.) Howell: *2648*, July 17, 1920, Maple Canyon branch of Coal Creek Canyon, near Cedar City, Iron Co.

222* UROMYCES SUBSTRIATUS Sydow, Ann. Myc. **4**: 30. 1906.

On *Lupinus* sp.: *3102*, Oct. 6, 1923, East Canyon, Summit Co.; *3103*, Oct. 6, 1923, Gogorza, Summit Co.; *3104*, Oct. 6, 1923, 19½ miles up Parley's Canyon, Salt Lake Co. The rust was

very abundant, especially at the last-named location. A little observation should enable one to discover the aecial host. No plants of *Euphorbia robusta*, the alternate host of *Uromyces occidentalis*, are to be found anywhere near.

We are indebted to H. S. Jackson for determination of the rust.

223* PUCCINIA CREPIDIS-MONTANAE Magnus; Ed. Fisch. Beitr. Krypt. Schweiz. **2**[2]: 212. 1904.

Mentioned in N. Am. Fl. **7**: 440. 1921, as occurring in Utah on *Crepis glauca* (Nutt.) T. & G.

EAST HIGH SCHOOL,
SALT LAKE CITY, UTAH.

UN NUEVO GENERO DE LAS HELVELLACEAS

C. Spegazzini

Cudoniopsis Speg. gen. nov.

Char. Helvellea, geoglossea, hyalospora; sclerotium superficiale, irregulariter ellipsoideum, subcarnoso-lentum, extus viscosum olivaceum; ascomata plura discreta, sclerotio insititia, fusco-olivacea, stipite simplice terete gracili rigidulo subcorneo glabro laevi divaricato recto v. arcuato-adscendente fulta, pileolo apicali primo subhemisphaerico, margine involuto, serius digitaliformi v. anguste campanulato, crassiuscule membranaceo coronata; asci superficiem totam pileoli externam efformantes, lineares, apice poro pertusi, paraphysibus filiformibus apice non incrassatis rectisque aequilongis obvallati, octospori; sporae e globoso ellipsoideae, monostichae, laeves, fumoso-olivascentes.

Cudoniopsis pusilla Speg. sp. nov.

Diag. Characteres generis; sclerotia pro ratione majuscula, extus colliculoso-viscosa; ascomata pusilla sub rore viscosula sclerotio obscuriora; asci cylindracei apice obtusi crassiusculeque tunicati, deorsum breviuscule cuneato-pedicellati; sporae ellipsoideae parvae.

Hab. Sobre ramas vivas, de dos o tres años de edad, de *Eugenia proba* Brg. en los alrededores de Puerto Blest, Neuquen, Agst. 1921.

Obs. Este curioso honguillo es el primer tipo biófilo y parasto que se viene a conocer entre las Helvellaceas, pues todas las demas conocidas hasta ahora resultan saprófilas o geófilas. Cuando coleccioné este micromiceta, creí que fuera parasito de las semillas de alguna Lorantacea o que se tratara de un organismo coprófilo sobre escrementos de alguna ave; recien al estudiarlo me dí cuenta de que el cuerpo maciso sobre el cual aparecian los ascomas era un esclerocio; este tiene forma elipsoide bastante irregular (5–6 mm. lng. x 2.5–3 mm. lat. et alt.) completamente superficial sobre la corteza del huesped, al cual adhiere por un escaso micelio penetrante endógeno y por la viscosidad de que va revestido; su superficie es levemente undulada lisa lampiña de

color olivaceo mas o menos subido, cuando húmedo cubierto de una capa mucilaginosa viscosa de la misma coloración; su parte interna es compacta de tinte verde sucio, formadas por cortas hifas (5–10 μ diám.) fumosas muy enmarañadas de paredes gruesa y luz interna reducida; los ascomas mas o menos numerosos (3–10 μ) crian generalmente en la parte basal del esclerocio,

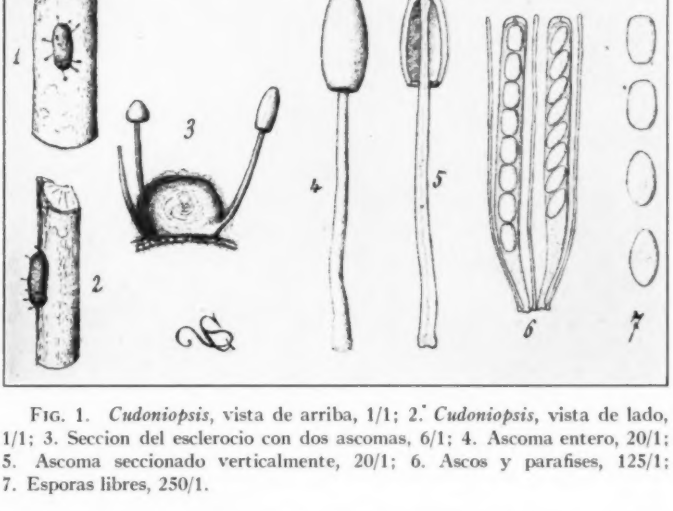


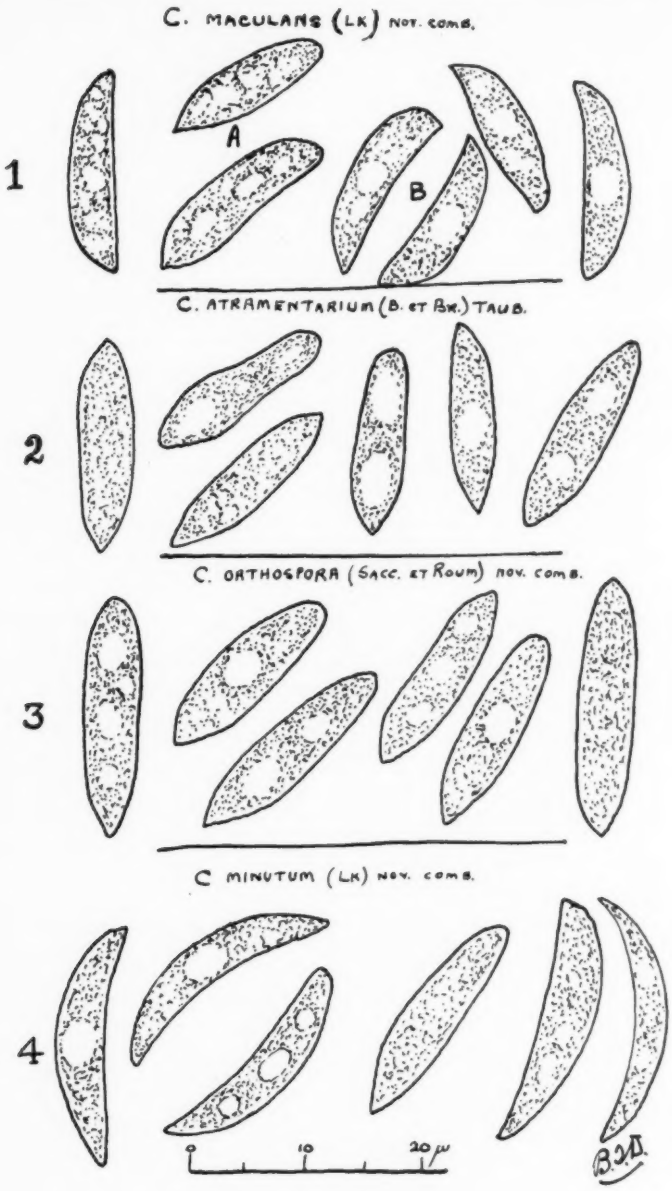
FIG. 1. *Cudoniopsis*, vista de arriba, 1/1; 2. *Cudoniopsis*, vista de lado, 1/1; 3. Seccion del esclerocio con dos ascomas, 6/1; 4. Ascoma entero, 20/1; 5. Ascoma seccionado verticalmente, 20/1; 6. Ascos y parafises, 125/1; 7. Esporas libres, 250/1.

bien separados uno de otro, hallándose formados por un estípite y una cabezuela; los estípites sencillos, rectos o arqueado-ascendientes son bastante largos pero delgados (1.5–5 mm. lng. x 100–150 μ diám.) lisos lampiños, a veces algo viscosos, rígidos pero no corneos, por dentro rellenos y del mismo color del esclerocio o un poco mas obscuros; la cabezuela o sombrerillo himenióforo en la primer edad es casi semiesférico con los bordes inferiores enroscados para adentro, mas tarde toma la forma de un dedal (500–750 μ lng. x 200–350 μ diám.) y sus bordes son entonces derechos y arrimados al estípite, asemejándose a un pequeñísimo coprinus; su superficie externa e inferior es lisa de color ceniciento verdoso sin viscosidad, mientras la interna (aparentemente

externa) y superior es tambien lisa, mas obscura olivacea y algo viscosa; el espesor de la pared himenofórica es limitado, variando de 90 a 110 μ; cuando fresca es blanda y flexible, pero secándose se vuelve rígida y dura; estando constituida por dos capas, la inferior estéril fibrosa, la superior fértil ascófora; los ascos son cilíndricos (60–70 μ lng. x 6–8 μ diám.) en el ápice obtusamente redondeados casi truncados con membrana algo espesada y pequeña perforación central, posteriormente adelgazados en pedicelo relativamente corto que apenas alcanza a cuarta o quinta parte de la longitud total, conteniendo cada uno 8 esporas en una sola hilera vertical, y siendo acompañados de numerosos parafises filiformes de su misma longitud y sin engrosamiento ni ramificación apical; las esporas uniloculares son elipsoideas (6–8 μ lng. x 3.5–4 μ diám.), mas o menos obtusas en los extremos, revestidas de membrana delgada y lisa, sin vacuolos internos, trasparentes, pero de color olivaceo pálido.

Bajo el acción de la tintura de yodo la extremidad superior de los ascos toma ligera coloración azul.

La PLATA, ARGENTINA.



SPECIES OF COLLETOTRICHUM

COLLETOTRICHUM *v.* VERMICULARIA

B. T. Dickson

(With Plate 21)

While engaged in a study of the organism concerned in a rather obscure potato disease—black-dot, dartrose, anthracnose or foot-rot—the writer examined exsiccati specimens of various species of *Vermicularia* occurring on potato. As a result of the examinations the question is raised as to the validity of the determinations and the fact becomes apparent that the genus *Vermicularia* needs thorough monographic study.

By the kindness of Dr. A. W. Hill, Director of the Royal Botanic Gardens at Kew, England, the following exsiccati were placed at my disposal: 1. *Vermicularia maculans* (Link) Desm.; 2. *Vermicularia atramentaria* B. & Br.; 3. *Vermicularia minuta* (Link) Lib.; 4. *Vermicularia orthospora* Sacc. & Roum.

Vermicularia maculans

Link in his *Species Hyphomycetum et Gymnomycetum* (Species Plantarum Linnaei IV, **2**: 123) of 1825 described *Exosporium maculans* as occurring on potato stems in France and Belgium. Fries in his index to volume 3 of the Systema Mycologicum (1829) gives *E. maculans* Link as a variety of *Vermicularia Dematium* Fr. which also occurs on potato stems. While spore sizes are approximately the same, those of *V. Dematium* are falcate and those of *E. maculans* straight, or but slightly curved. On this basis Desmazieres in his *Plantes Cryptogames du Nord de la France* renamed it *Vermicularia maculans*, which was accepted by Fries in his *Summa vegetabilium Scandinaviae* of 1849. It is described in the Syll. Fung. **3**: 228 as:

"Vermicularia maculans (Link) Desm. Exs. n. *339*, *Exosporium maculans* Link. Sp. plant. Fung. II, p. 123.—Peritheciis innatis, minutis, aggregatis, dein confluentibus et matricem nigrificantibus, rotundatis, applanatis, setulis concoloribus, sparsis, fasciculatis, apicem versus attenuatis, divaricatis obsitis, denique apice

hiantibus; sporulis (paucis) elongatis vel oblongis, rectis, subobtusis.

"*Hab.* in caulibus plantarum herbacearum, praecipue Solani tuberosi et Urticae urentis in Gallia et Belgio."

Examination of a small piece from the specimen showed the organism in various stages from that in which there was a small acervulus with spores and two setae to a setose sclerotial body with no spores.

The long desiccation of the specimen made it difficult to obtain good definition in photomicrograph, but it serves to illustrate the fact that the organism is not a *Vermicularia*. There is no true sporodochium and hence it may not be a *Volutella*. In my cultural studies of similar organisms the sclerotia occur either directly by the massing of mycelium giving a black pseudoparenchymatous structure, which never bears spores (or but rarely and sparsely), or they are built up by mycelium growing around the bases of setae until the tips only of the setae project. In the latter case spores may still be borne on the up-growing mycelium. There is no evidence of differentiated cortical layer which afterwards ruptures such as described by Stevens (1) in his study of *Volutella circinans* (Berk.) Stevens.

Careful comparison of such slides as I have available leads to the conclusion that the organism known as *V. maculans* is a *Colletotrichum* inasmuch as the spores occur in acervuli with no evidence of sporodochia, and there is no evidence of a pycnidium warranting the name *Vermicularia*.

On this basis therefore *Vermicularia maculans* becomes **Colletotrichum maculans** (Link) comb. nov. with synonymy: *V. maculans* (Link) Desm.; *Exosporium maculans* Link.

Additional to the description in Sylloge Fungorum the following facts are now available. The spores are 17.5–20 μ long by 4–5 μ wide, straight to very slightly falcate. The surface of the spore turned to the middle of the acervulus is straight to slightly curved, while the outward-facing surface is curved and tapering suddenly at the ends. (See Pl. 21, fig. 1.) The sporophores are 8–17.5 x 3 μ and fascicled; the setae fascicled, bulbous at base, 5 μ x 125–150 μ and commonly thrice septate.

VERMICULARIA ATRAMENTARIA

Berkeley and Broome's *Vermicularia atramentaria* appeared in 1850, and the technical account in Saccardo's Syll. Fung. **3**: 227 is given herewith:

"Berkeley and Broome Ann. N. H. n 430.—Effusa, gregaria, atra, maculiformis; peritheciis minutis superne setulis longis rectis, basi vero fibris repentibus, subepidermicis cinctis; sporulis minutis, cylindraceis, brevibus, utrinque nucleatis, (plasmate utrinque retracto, Berk.).

"*Hab.* in caulibus Solani tuberosi in Britannia, Italia, Gallia, Belgio, Germania.—*Verm. maculans* (Link) Fr. Summa V. S. p. 420, Kickx Fl. Fl. I: p. 405, valde affinis est, nisi eadem ac *Verm. atramentaria* B. et Br."

Examination of this material leads to the conclusions that *V. atramentaria* is really *Colletotrichum atramentarium* and that it is not the same as *C. maculans*. The former conclusion was arrived at by Taubenhaus (**2**) in 1916 as a result of studies of material at the New York Botanical Garden and my studies support his view but not his synonymy. On page 554 of his paper the statement is made: "It seems evident that *Phellomyces sclerotiophorus* Frank is the same as *Vermicularia atramentaria* Berk. & Br. and also the same as *Colletotrichum solanicolum* O'Gara. However, in following the rule of priority, the fungus becomes *Colletotrichum atramentarium* (Berk. & Br.) Taubenhaus. Syn. *Vermicularia atramentaria* Berk. & Br., 1850; *Phellomyces sclerotiophorus* Frank, 1897; *Colletotrichum solanicolum* O'Gara, 1915."

Concerning this more will be said in another paper. The actual synonymy in my opinion is: *Colletotrichum atramentarium* (B. & Br.) Taub.; *Vermicularia atramentaria* B. & Br.; *Colletotrichum solanicolum* O'Gara.

The similarity between *C. maculans* and *C. atramentarium* is quite marked in appearance on the host in the exsiccati, in spore size, sporophore shape and size, setae and sclerotia. In fact until I had examined many spores, I was doubtful that there was sufficient specific difference. A majority of the spores of *C. maculans* are shaped somewhat like a glume or a lifeboat (naviculoid?) as in Plate 21, figure 1*B* with a minority like figure 1*A*. With *C. atramentarium* the majority of spores are short cigar- or torpedo-shaped as in figure 2. On this basis therefore they are maintained as different species.

VERMICULARIA MINUTA

Libert renamed Link's *Exosporium minutum* in 1837 in his Pl. Crypt. Arduennae Fas. IV. No. *350*. The specimen lent me by Dr. Hill was *ex*. Herb. Hort. et Bot. of Belgium and occurred *in caulibus herbarum aridis Autumno*.

This also has the characteristics of a *Colletotrichum* and not of a *Vermicularia* and hence should be **Colletotrichum minutum** (Link) comb. nov. with *Vermicularia minuta* (Link) Lib. and *Sphaeria Dematium* b *minor* Fries as synonyms.

The spores are slightly curved, fusiform, 20–22.5 by 3.75–5 μ (see Pl. 21, fig. 4); sporophores fasciculate, 15–22 x 3–3.75 μ; setae 150–200 x 7.5 μ, often bulbous at base, tapering and rarely hyaline at tip. The statement is made in Saccardo, Syll. Fung. **3**: 228, "An satis diversa a *Verm. Dematio?*" and the writer is awaiting an authentic specimen of *V. Dematium* to make the comparison.

VERMICULARIA ORTHOSPORA

One specimen from Kew was from Roumeguère's collection and was labelled

"C. Roumeguère. Fungi selecti exsiccati
5463 Vermicularia orthospora Sacc. et Roum. Mich. II, p. 630—Syll. III, p. 227.
Sur Tiges desséchées du *Solanum tuberosum* Nordan (Coté d'Or) janvier 1890.

F. Fautrey."

This on examination was not a *Vermicularia* but appeared to be a *Colletotrichum* although not so many acervuli free from the pseudoparenchymatous sclerotial mass were obtained. Spores were 18.75–22.5 x 3.5–4.5 μ continuous, straight to slightly curved (see Pl. 21, fig. 3); sporophores 8–20 x 3–3.5 μ, fasciculate; setae 150–200 x 5–6 μ, slightly swollen at the base, slender and sometimes sub-hyaline at tip.

A second specimen from Kew (*684* Coll. Libert) gave only sclerotial bodies, rarely setose, and with no spores.

A specimen kindly lent me by Dr. Seaver from the New York Botanical Garden was not an anthracnose but a pycnidium-producing organism.

Again therefore the *Vermicularia* should be a *Colletotrichum*, **Colletotrichum orthosporum** (Sacc. et Roum.) comb. nov.

VERMICULARIA VARIANS

Ducomet in 1908 (**3**) described this organism causing dartrose of potato as follows:

"Pycnides érumpentes superficielles à maturité, 15–150 μ, astomes, pourvues de poils noirs raides, de 100 à 130 μ x 3.5–4 biseptés, légèrement renflés à la base, atténués pâles au sommet. Spores un peu courbes, acuminées, hyalines, guttulées 18–22 μ x 2.5–3 μ. Stérigmates incolores ou à base brune 22–30 μ x 3–3.5. Espèce variable, évoluant vers les Phoma ou inversement vers les Colletotrichum et Gloeosporium."

"Parasite de la pomme de terre (tige, racine, rhizome, tubercule) de la tomate, du *Physalis peruviana*. (Ecole d'Agriculture de Rennes.)"

Dr. Pethybridge wrote me in December 1923 concerning this organism—that: "I no longer had *C. tabificum* in culture, but my former colleague, Mr. Lafferty, and I examined these cultures very carefully and could find no difference between them and our *C. tabificum*. We were, as you see, unable actually to make parallel cultures at the time, but I have no doubt that the two things are the same. Since then I have sent fresh material of *C. tabificum* on potato stalks from Lancashire, England, to M. Foex and in a letter to me dated the 14th of this month he states: 'L'identité de votre *Colletotrichum tabificum* avec le *Vermicularia varians* de Ducomet n'est pas douteuse.'"

Studies in my laboratory (**4**) confirm this and show further that it is the same as *Colletotrichum atramentarium* (B. & Br.) Taub.

In conclusion it may be inferred from the herein described studies on five so-called species of *Vermicularia* occurring on potato that further study of the genus is likely to demonstrate that still more are really species of *Colletotrichum*.

MACDONALD COLLEGE, MCGILL UNIVERSITY,
CANADA.

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PRELIMINARY SURVEY OF HYPOXYLON POPLAR CANKER IN OXFORD COUNTY, MAINE

E. J. SCHREINER

The following preliminary notes on *Hypoxylon* poplar canker pertains to the disease of poplar caused by *Hypoxylon pruinatum* (Klotzsch) Cooke, and was first described by A. Povah.[1]

The data recorded here were obtained in Oxford County, Maine, about seven miles from Andover. One set of figures was based on trees growing singly or in clumps on the cleared land along the road for a distance of about a mile. A second tally was made on a strip about 1.5 miles long and about 25 to 30 feet wide, extending up the side of the ridge to the east of the road. This hillside is covered by a mixed hardwood stand in which maple and paper birch predominate, with yellow birch and poplar (*P. tremuloides* Michx.) second in amount and with a scattering of beech and of conifers. The poplars, as is often the case, are not scattered, but occur in groups throughout the stand. Those in the forest stand are larger and older than the trees tallied in the open.

Cankers were tallied as *Hypoxylon* canker when they could be identified as such, otherwise they were recorded as unidentified. Some of the unidentified cankers were probably caused by *Hypoxylon*, and from previous observations it is suspected that most of the remainder were due to *Cytospora chrysosperma*, which is also common in this region.

The percentage of *Hypoxylon* canker in the open is almost twice that in the forest stand. The percentage of unidentified cankers on the other hand is less in the open than in the forest. These differences are no doubt due to some extent to the fact that in the open the cankers are lower and more readily identified. If the total number of all infections is considered, the trees in the

[1] Povah, A. *Hypoxylon* poplar canker. Phytopathology **14**: 140-145. 1924.

TABLE I

SHOWING NUMBER AND PERCENTAGES OF TREES INFECTED

	No. trees tallied	No. trees infected		Total no. infections	Per. trees infec.		Per. total infections
		Hypox. canker	Unident. cankers		*Hypox.* canker	Unident. cankers	
Trees in forest stand	226	25	20	45	11+%	8.8+%	20.1+%
Trees in open.....	103	22	4	26	21.3+%	3.8+%	25.2+%

TABLE II

SHOWING POSITION OF CANKERS ON TREES OF *Populus tremuloides*

Trees in Mixed Hardwood Stand (Total No. trees tallied 226)

Dia.	*Hypoxylon* canker region infected			Unidentified cankers region infected			Healthy trees
	Upper ⅓	Middle ⅓	Basal ⅓	Upper ⅓	Middle ⅓	Basal ⅓	
2″–4″	1+*3**		1	*2+3*	*3+5*	—	73
4″–8″	7+*1*			*2+3*	1	—	60
8″–12″	6+*5*	1		1	—	—	40
12″+	—	—	—	—	—	—	8
Totals	23	1	1	11	9		181

* Italics indicate that trees are dead.

Trees Growing in Open (Total No. trees tallied 103)

2″–4″	7+*1*	*2*	*3*	1	1	2	71
4″–8″	—	1	6	—	—	—	6
8″–12″	—	—	1+*1*	—	—	—	—
12″+	—	—	—	—	—	—	—
Totals	8	3	11	1	1	2	77

open still show a higher percentage of infection. This may indicate a correlation between age and susceptibility (the trees in the open are younger), but the factor of spore dispersal must also be considered.

From the figures given above it is apparent that there is a difference in the position of the cankers on the trees in the open

and in forest growth. In forest growth almost all the cankers are in the upper one third of the tree, whereas on trees in the open the greatest number of cankers are near the base of the tree. This difference in the part of the tree infected may be due to several factors: the mode of spore dispersal, inability of spores to germinate on the older parts of bark, method of entry of the fungus (whether directly through the bark of the trunk or through a twig), and the factor of age of the tree.

There are several groups of *P. tacamahacca* Mill.[2] on the area in which these observations were made. These have originated as root sprouts from individual trees planted near old farm houses which have since been abandoned. No *Hypoxylon* canker was found on any of these although a wide range of ages was represented, and infected trees of *P. tremuloides* were close by. In considering stands of poplar from a silvicultural standpoint, the susceptibility of the species and varieties of poplar to this disease is to be taken into account. *P. tacamahacca* seems to be immune, and there are undoubtedly other species and varieties which are also more or less immune.

SUMMARY

1. Cankers on older trees in forest stands of poplar are found for the most part in the upper part of the trees. Cankers on trees in the open (younger trees) are found near the base of the tree.

2. For the same locality the percentage of infection in the open was 21%, in the forest stand it was somewhat lower.

3. No cankers were found on *P. tacamahacca* Mill.

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[2] Sargent, Notes on North American Trees. Jour. Arnold Arboretum **1**: 61–63. July 1919.

NOTES AND BRIEF ARTICLES

Dr. Chas. Thom, of Washington, recently visited the Garden in connection with work on *Aspergillus*. For a number of years Dr. Thom has been carrying on culture work with the plants of this genus and proposes soon to publish the results of his investigations.

Professor H. M. Fitzpatrick, of Cornell University, spent some time at the Garden during the summer, continuing his studies on certain groups of the Pyrenomycetes, which are badly in need of revision.

Dr. L. O. Overholts, of Pennsylvania State College, spent a part of his summer vacation as a research student at the Garden. Dr. Overholts devoted his time to a critical study of the basidiomycetes of Porto Rico, the results to be embodied in the Flora of Porto Rico and the Virgin Islands.

Professor H. H. Whetzel, of Cornell University, spent some time at the Garden immediately after the close of the school year, continuing his studies of certain parasitic fungi destructive to ornamentals.

The largest local morel which has come to our attention was recently brought into the laboratory by Mrs. Wheeler H. Peckham, having been collected in her garden at New Rochelle. The specimen measured four inches in diameter and nearly six inches high. The species is probably *Morchella crassipes*.

Mr. Rafael Toro, of Porto Rico, who has been spending a year at Cornell University, was a summer student at the Garden. Mr. Toro is spending his time while in the states in a critical study of the fungi of Porto Rico. One paper has already been published by him in MYCOLOGIA.

Professor C. R. Orton has been granted a year's leave of absence from the Pennsylvania State College to take up investigations on seed-borne parasites for the Boyer Company, Inc., under the direction of the Crop Protection Institute. The work is being carried out at the Boyce Thompson Institute for Plant Research at Yonkers, N. Y., where most adequate facilities are being furnished both in laboratory and field. The studies include organic mercurial compounds as well as standard disinfectants for seeds and their effect upon plant growth.

Dr. E. M. Gilbert, of the University of Wisconsin, has spent two months as a guest of the State Plant Board of Florida and during his stay has given attention to a study of the fungi that attack the aphis which is causing serious damage in the citrus groves of the state.

The studies, so far made, indicate that several fungi attack the aphis and efforts to culture some of these fungi will be continued by Mr. W. A. Kuntz of Pennsylvania State College, who is now stationed at the newly established Citrus Experiment Station at Lake Alfred, Florida. O. F. BURGER.

DISCOMYCETES OF AUSTRALIA

For several years past the writer has been in communication with Miss Ethel McLennan of Melbourne, Australia, who is making an intensive study of the genus *Lamprospora* and allied genera of cup-fungi. One of the facts brought out in the course of this work is the striking similarity between the species collected in Australia by her and those collected in North America by myself (see illustrations in MYCOLOGIA **6**: *pl. 114*). Microscopic slides of the spores which furnish the chief diagnostic characters of the species of the genus are so similar that it is difficult and sometimes impossible to distinguish between those of the plants so widely separated geographically. In several cases she has been compelled to refer them to the names proposed for the North American species, while in other cases there is not more than a varietal difference.

The first paper dealing with the subject "Additions to the Australian Ascomycetes. No. 1" has recently appeared (Proc.

Roy. Soc. Victoria II. **35**: 153–158. *pl. 9, 10*). In this paper Misses McLennan and Cookson record *Lamprospora tuberculata* Seaver as occurring in Australia, in this case the Australian and American plants being so similar that they could not be specifically separated. They also call attention to the fact that *Barlaea verrucosa* described by Rodway from Tasmania (Proc. Roy. Soc. Tasmania **1920**: 158) is identical with the American species just named.

A new variety of a second species, *Lamprospora areolata* Seaver, variety *australis* McLennan and Cookson, is also recorded and well illustrated. The new variety is identical with the American species so far as spore characters are concerned. It differs, however, in the slightly larger size of the plants and in the delicate fringe which borders the apothecia, the latter character not having been noted in the American form. It is possible that even these apparent differences might disappear when the plant has been studied more extensively in this country. On account of the minute size of the plants, they are seldom seen, and the only American material of this species consists of a half dozen collections made in the vicinity of New York City by the writer. It is a pity that a wider interest cannot be had in these minute but extremely interesting forms of plant life. Such an interest would doubtless reveal a wide distribution for many of the species now so poorly known.

In the same paper a new species of *Sphaerosoma* is described, *Sphaerosoma alveolatum*. In the general appearance of the plants and spores this species is very similar to *Sphaerosoma echinulatum* of the writer which was later transferred to the genus *Boudiera*. The Australian plant differs, however, in having alveolate instead of echinulate spores. The authors of the Australian species seem to detect a difference in the apothecial characters between the American and Australian forms. So far as the writer can judge from the illustration the apothecial characters are very similar. The gradations also between the alveolate and echinulate characters of the spores are very misleading, so that we are inclined to wonder if the Australian plant is not also a species of *Boudiera*, identical with either the European or the American species which are themselves scarcely more than geographical forms of the same species.

Miss McLennan indicates in her correspondence that other species of *Lamprospora* have been collected by her which are apparently identical with American forms described by the writer, while still others appear to be undescribed. She and her associate are to be congratulated on the appearance of their first paper on this subject which we hope will be followed by others. Especially are we interested in their efforts to coördinate the mycological work of these two far away lands.

FRED J. SEAVER